I. *Obſervations on the Seed-Veſſels and Seeds of* Polypodium. *In a Letter from Mr* Anthony Van Leeuwenhoek, *F. R. S.*

Delft *in* Holland, *April* 24, 1705.

WHen I was a few years ago at a place where *Polypodium* grew, I viewed the Seed Veſſels, that were in great numbers upon its Leaves; and when I placed ſome pieces of a Leaf before a Microſcope, I obſerved, as did ſeveral others that were with me, the Seed Veſſels appearing like ſo many round Globules; and that ſoon one and ſoon another of them burſt before our Eyes, which ſpectacle ſeem'd exceeding ſtrange to us. And lately, in the middle of the laſt Winter, there fell into my hands two Leaves of Fern, that grew upon the ſtump of an old Willow Tree, and were almoſt wither'd; the which Leaf we call Oak Fern.

This Leaf had a great deal of Seed in it, but the Seed Veſſels thereof were much larger than the Seeds of the Fern that grow in the Country.

I obſerved ſeveral little Bundles or Parcels of theſe Seed Veſſels, ſometimes thirteen of them lying in a row by one another.

Having never taken notice before, how large the Plant called the Oak Fern grows upon the Trees, I betook my ſelf in the month of *February* laſt to a certain place, where there were old Willow Trees growing upon the Banks of a Canal, the which Trees were no taller than the length of a Man: The Boughs or Branches of which had been lopt

lopt off for four or five years together; which are moſtly uſed by the Boors to make Hedges or Fences for their Grounds and Dwelling places; a great many of which Willow Trees, by the Lopping of their Branches, periſh: And upon the rotten Wood of ſuch Trees grows the *Polypodium* or Fern.

From three or four of thoſe Trees I pull'd off the Fern, and I obſerved in all thoſe that I meddl'd with, the Plant was no larger than a ſingle Leaf.

Theſe Leaves were of different ſizes, ſome ten times larger than others, and ſome of them were not above two fingers broad, yet they alſo had Seed in them.

From theſe Obſervations, I infer, that the great Leaves had grown ſeveral years before they arrived at their preſent bigneſs; and the more, becauſe the Roſe-like parts were not near ſo large upon the little Leaves as they were upon the great ones; and conſequently the Seed Veſſels fewer in number upon the one than the other.

Among that Fern that I brought home with me, I planted eight or ten that had thick ſhort Roots; and from which Roots there came new ſmall Branches, and moſtly two ſuch Branches ſprung out of one Root: But I had one from whence four proceeded. I planted them in a Flower-pot, with fitting Earth about them, that I might purſue my Obſervations as often as I found my ſelf diſpoſed to it.

I cauſed my Painter to draw the greateſt part of one of the largeſt Plants, to ſhew you the many Seed Veſſels that are upon the ſame, together with the unſpeakable number of ſmall Seeds that are ſhut up in each Veſſel.

Fig. 1. A B C D E F repreſents the largeſt part of an Oak Fern Plant, which I call a Leaf, becauſe it has no Root, but only a Stalk; and foraſmuch as part of the Leaf was divided into ſeventeen Branches, whereof A B G is one, we may conclude that the whole Leaf conſiſted of a great many more.

Now

Now I have often counted in one Branch only of ſuch a piece of a Leaf, and in one row only of ſuch a Branch as deſcribed by A B, 13 of thoſe little Particles, which to the naked Eye appear like Roſes; and conſequently in the whole Branch A B G, ſix and twenty of the ſame in two Rows, which I ſhall call Seed Veſſels; and when I ſeparated one of theſe Seed Veſſels from the reſt, I obſerved that all of them had very ſhort kind of Staiks, whereby they were faſtened to the Leaf, and by which they received their Increaſe, but to the Eye appear'd no bigger than a Point, and the Leaf ſeem'd clearer or more tranſparent there, in which place I judge there was a Canal or Vein of the Leaf.

Having ſeparated one of theſe Roſe-like parts from the Leaf, and alſo as well as I could the Seed Veſſels of which it was compoſed, from one another, I found that the number of thoſe Seed Veſſels amounted to 149.

But in obſerving others I did not find the number ſo great, which was at ſometimes 120, at others 130.

Almoſt all the Seed Veſſels were open, and in ſome of them not the leaſt appearance of any Seed.

This openneſs ſeem'd at firſt very ſtrange to me, becauſe I could not perceive in any of them that it was occaſion'd by any burſting or breaking in pieces; but when I conſider'd the matter better, I fancied to my ſelf that Nature had ordered it ſo in thoſe Seed Veſſels, that as ſoon as the Seed was ripe, and received no further Nouriſhment, the Seed Veſſels ſhould open of courſe.

Fig. 2. H I K L M repreſents one of thoſe Seed Veſſels, that was open'd more than the reſt, and whereby the Seeds, as I imagine, were thrown out, as it always happens in thoſe Seed Veſſels that open of themſelves; for I could not perceive at the Orifice the leaſt Rent or Breach: The ſaid Orifice is repreſented by L M.

In

In the ſaid Figure, between H and O, you may obſerve 8 Screw-like parts; and of this Configuration are all the Seed Veſſels.

Let us ſuppoſe now that when the Seed is ripe, and receives no further Nouriſhment,it,and particularly its Shell or Veſſel, which for the moſt part is compoſed of a thin Membrane, ſhrinks in, by reaſon that its moiſture in dry weather is all exhal'd; now this ſhrinking in is greater in the 8 Screw-like parts, that are deſcribed between H and O, than in any other part of the Seed Veſſel, becauſe that the Screw-line parts are there of more than an ordinary thickneſs, in compariſon of the other parts of the Seed Veſſel; by which extraordinary ſhrinking the Seed Veſſels are forc'd open, and the incloſed Seed thrown out.

I have met with ſome of the ſaid Fern Leaves, in which the Seed Veſſels had not been yet open'd, and conſequently had ſhed none of their Seeds.

I have opened ſeveral of theſe Seed Veſſels, and viewed the Seeds with a Microſcope, it being impoſſible for me to ſee them with my naked Eye, or even with common Spectacles: I have counted above 50 Seeds in one of thoſe Seed Veſſels, the which Seeds appeared thro the Microſcope like theſe 3, which I have cauſed to be drawn Fig. 3. P.Q.R.

I placed ſome of thoſe Seeds before a Microſcope, that was more magnifying than the laſt, and charged the Painter to draw it juſt as big as it appeared to him thro the ſame Glaſs, as you may ſee in Fig. 4. S T. and foraſmuch as the ſame Seed ſeem'd much greater to my Eye, I cauſed it to be ſo drawn, or rather ſmaller than it really appear'd to me, as in Fig. 5. V W.

And tho the Seeds did appear as ſmall as in Fig. 3. yet one might perceive the Spotted Particles wherewith the Seeds were adorned.

Now if we turn our thoughts upon the Stalks of theſe Seed Veſſels, as they are repreſented in Fig. 2. NH, and if we let them wander beyond our ſight, which can penetrate no farther than into the Internal Canals or Veſſels, of which there lye an unſpeakable number in the ſaid Stalks, we may ſafely affirm, not only that the Seed Veſſels are produced and fed from the ſame, but alſo that in ſuch Seed Veſſels there may lye 50 or more Seeds, each of which may be indued with particular Canals or Veſſels; and have moreover a Shell or Membrane without, and a Plant within; all which lye in ſo exceeding ſmall a Compaſs, and have ſuch an unſpeakable number of Veſſels in them, that one can hardly form any manner of Idea of them.

I cauſed the Painter to draw another Seed Veſſel, which was not open as the former: And whereas in Fig. 2. the Screw-like parts of the Seed Veſſel are placed oppoſite to the ſight, in this laſt the ſame parts appear ſideways.

Fig. 6. ABG repreſents the Stalk thereof, BCDEFG the Seed Veſſel itſelf, and EF the opening of that Veſſel whereby it diſcharges its Seed.

I cauſed alſo another Seed Veſſel to be drawn, that had not yet open'd itſelf, and conſequently in which the Seeds are ſtill ſhut up.

Fig. 7. HIM ſhews the Stalk, and IKLM the Seed Veſſels, in which the Skrew-like parts are intercepted from the ſight; and it is ſo placed that you can't at all perceive whereabouts the opening ſhall happen.

In the ſaid Seed Veſſel you may obſerve the wonderful Fabrick of the Membrane whereof it is compoſed, and the exact Order and Regularity of the Seams or Ribs thereof; but when I ſhew'd a certain Gentleman the ſame Order and Uniformity in another Creature, he ask'd me to what end it was ſo Created, ſince it was never to be ſeen by the naked Eye.

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The Shell or Skin of theſe Seeds is compoſed of ſo exceeding a thin Membrane, that the Wind, or even the Seeds themſelves that are encloſed by it, would eaſily break it, were it not fortified or ſtiffned by thoſe parts that I call the Ribs or Seams thereof, the which are much thicker than the reſt of the Membrane, and thereby both the Seed and the Veſſels themſelves are preſerved.

When I ſhew'd a certain Gentleman, by the help of a Microſcope, one of theſe Seed Veſſels, as alſo the Seeds that I had taken out of it, he was very deſirous to know of what ſubſtance thoſe Seeds were compoſed; but I thought 'twas impoſſible for me to ſatisfie him by Diſſecting one of thoſe Seeds; yet, having further conſider'd of his Requeſt, I found out a means of breaking one of theſe ſmall Seeds ſo cleverly, that no foreign Matter ſhould intervene, or be mixt with it.

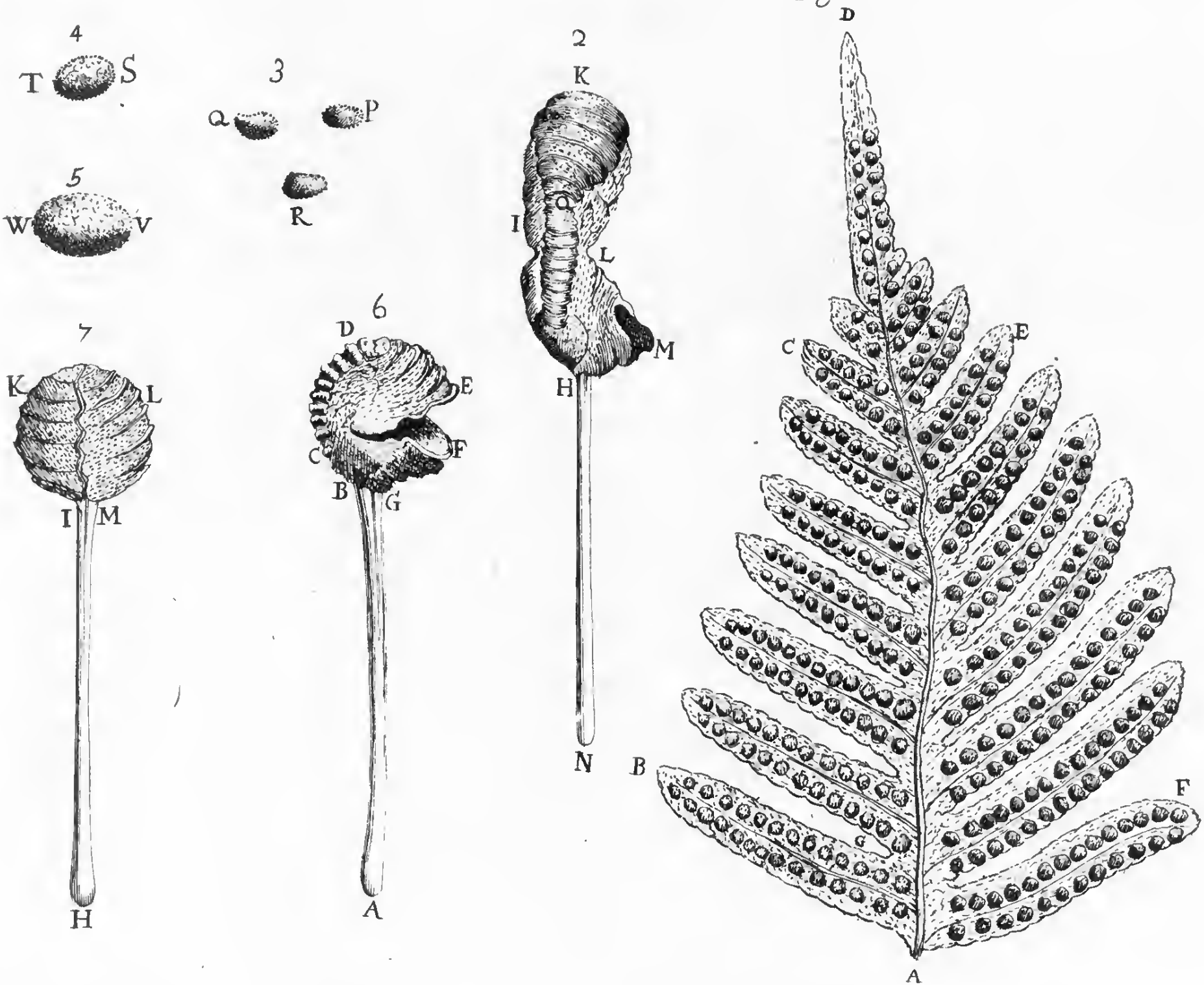
In doing this, I was mightily ſurpriz'd to find a great deal of Oyl coming out of one of them; and as each of theſe Seeds was of a Yellowiſh Colour, ſo was the Oyl alſo, where 'twas a little thick; but where it was thinner, it was as clear as any Water; the other Particles, that lay in and about the Oyl, were of an exceeding ſmallneſs.

I made but one little Hole or Breach in the Seed, whereby to ſqueeze out the Oyl, and the other Particles wherewith it was filled; which having done, I obſerved that the Skin or Membrane of the Seed had no Colour at all in it; and then I could ſee a great many more Figures in the ſaid Membrane, than were diſtinguiſhable in it before: Ad as all Seeds, that are viewed with any exactneſs, may be diſcover'd to have two Membranes, ſo it is not improbable that theſe have two likewiſe.

Now when we conſider the exceeding ſmallneſs of the abovemention'd Seeds, 'tis eaſie to conceive how the ſame, after that they are full ripe, may be ſcatter'd

abroad with a brisk Wind, and ſome of 'em conſequently may fall upon old Rotten Trees, and from thence receive their Nouriſhment and Increaſe.

I mention'd before, how the Seed Veſſels upon the Leaves of Fern, open'd themſelves (whilſt I was obſerving them) in order to ſhed their Seed.

For my further ſatisfaction in this matter, I took a Fern Leaf, in which the Seed Veſſels being quite ripe, were for the moſt part open, and had diſcharged their Seed, and put it into boyling hot Water; in this expectation, that the hot Water inſinuating itſelf immediately into the Screw-like parts, as they are repreſented in Fig. 2. between H and O, would ſo extend or ſwell out thoſe parts, that the Seed Veſſels would reſume the ſame figure or appearance as when they were full of Seed; and this Experiment I repeated ſeveral times, and always obſerved that almoſt all the Seed Veſſels ſhut up themſelves, juſt after the ſame manner as they were before they diſcharged their Seed; and when I ſpread thoſe Seed Veſſels abroad, and let them dry again, they were all of them as open as that which is repreſented by Fig. 2.

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